Challenges and Opportunities of CO$_2$ Capture and Storage in the Iron and Steel Industry: Understanding the Overall Perspective

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European Bank for Reconstruction and Development
9th November 2011
The additional investment needs for CCS over the 2010 to 2050 period are about USD 882 billion; total additional costs are over USD 3 trillion.

Abatement costs range most widely between and within sectors.

Source: IEA/UNIDO "Technology Roadmap, Carbon Capture & Storage in Industrial Applications (September 2011)
22 SITES OVER 2.0mt CO₂ 2008

<table>
<thead>
<tr>
<th>Site</th>
<th>Mt CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Bremen</td>
<td>2.0</td>
</tr>
<tr>
<td>SSAB Oxelosund</td>
<td>2.3</td>
</tr>
<tr>
<td>Lucchini Piombino</td>
<td>3.2</td>
</tr>
<tr>
<td>AM Sollac Lorraine</td>
<td>4.15</td>
</tr>
<tr>
<td>Salzgitter Glocke</td>
<td>4.2</td>
</tr>
<tr>
<td>Rautaruuki</td>
<td>4.4</td>
</tr>
<tr>
<td>AM Gent</td>
<td>4.5</td>
</tr>
<tr>
<td>VoestAlpine Linz (inc. coke ovens)</td>
<td>4.6</td>
</tr>
<tr>
<td>AM Espana</td>
<td>5.4</td>
</tr>
<tr>
<td>Dillinger</td>
<td>5.5</td>
</tr>
<tr>
<td>Teeside (now SSI)</td>
<td>6.2</td>
</tr>
<tr>
<td>AM Ostrava</td>
<td>6.4</td>
</tr>
<tr>
<td>Tata Ijmuiden</td>
<td>6.4</td>
</tr>
<tr>
<td>AM Fos</td>
<td>6.45</td>
</tr>
<tr>
<td>AM Poland (inc. coke ovens)</td>
<td>6.8</td>
</tr>
<tr>
<td>Tata Scunthorpe</td>
<td>6.9</td>
</tr>
<tr>
<td>Tata Port Talbot</td>
<td>6.9</td>
</tr>
<tr>
<td>AM Galati</td>
<td>7.6</td>
</tr>
<tr>
<td>USSteel Kosice</td>
<td>8.96</td>
</tr>
<tr>
<td>Riva Taranto</td>
<td>10.7</td>
</tr>
<tr>
<td>AM Dunquerque</td>
<td>11.3</td>
</tr>
<tr>
<td>TKS Duisberg/HKM Duisenberg</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Total Group: 138.3 Mt CO₂
ArcelorMittal: 57.7 Mt CO₂ (ex-Teesside SSI)
Tata: 20.2 Mt CO₂ (ex-Teesside SSI)

Derived from EU CITL
GLOBAL COST CURVE
WORLD STEEL DYNAMICS - 2011

Hot Rolled Band Operating Costs

Source: World Steel Dynamics, October 2011
ARCELOR MITTAL
COMPETITIVE POSITION - 2010

Competitive position

- Competitive does not just mean low-cost
- More important is being competitive in target markets
  - Competitive on costs
  - Competitive on quality
  - Competitive on service
- We occupy a better-than-average cost position in the regions we are serving
- We have one of the largest R&D budgets in the steel industry; this supports our product quality and innovation
- We have a strong relationship with customers which reflects in our service quality

We have a strong competitive position today, but we can always improve

THE EUROPEAN MARGIN SQUEEZE
ARCELORMITTAL 2011 (9 months)

- Flat Carbon Americas (includes Brazil, NAFTA)
  EBITDA pt $: 111
  Operating Income pt $: 71
- AACIS (includes Kazakhstan, Ukraine, South Africa)
  EBITDA pt $: 106
  Operating Income pt $: 66
- Long Carbon Americas and Europe (includes Brazil, NAFTA)
  EBITDA pt $: 85
  Operating Income pt $: 42
- Flat Carbon Europe
  EBITDA pt $: 70
  Operating Income pt $: 16
  ★ before US$4 pt closure costs
ADDRESSING THE MARGIN CHALLENGE IN EU

Asset Optimisation (ArcelorMittal)
- Full utilisation of lowest cost plants
- Focus on automotive (30% of AM LCE)

Long-Term Relocation (Voestalpine)
- “Commodity grade(s)…likely to move to regions such as Russia, Ukraine, Turkey”
- “Europe has to refocus on top, top quality”
PIG IRON PRODUCTION (2010) (mt)

China: 590 mt
EU: 94.5 mt
Japan: 82.2 mt
Russia: 47.9 mt
India: 38.6 mt
S. Korea: 35 mt
Brazil: 30 mt
Ukraine: 27.3 mt
US: 26.8 mt

TOTAL WORLD PIG IRON PRODUCTION: 1,025 mt

Source: WSA
EU EXPORT OF GOODS - 2009

US$ billion

- Non-electrical machinery: $210
- Transport equipment (incl. automotives): $202
- Chemicals, other than Pharmaceuticals: $161
- Other manufactures: $141
- Fuels & Mining: $116
- Other semi manufactures: $113
- Pharmaceuticals: $111
- Agriculture (inc. food): $110
- Office & telecom equipment: $90
- Electrical machinery: $75
- Power generating machinery: $54
- Iron & Steel: $41
- Textiles & Clothing: $39

Source: WTO Trade Statistics
TACKLING CARBON LEAKAGE (UK Carbon Trust report 2010)*

- Choose approach based on characteristics of sectors
- for Steel:
  - Transitional Free allowances
  - Monitor potential leakage
  - Work with other countries:
    on mutual recognition of carbon leakage sectors and
    on options for border levelling for specific steel products
  - Objective to reflect full costs by 2020 by one of
    - import levelling
    - export adjustment by producer countries, or
    - carbon-cost reflecting global sectoral agreement

Source: by Michael Grubb and Thomas Counsell, cited in IEA/UNIDO 2011 report
STRAATEGIC ISSUES

- Investment Costs: financeability and profitability
- Operating Costs: need for climate-related trade policy?
- Implications for Location:
  - Within EU: Clusters? North Sea?
  - Outside EU: Challenge of lower cost locations for lower cost blast-furnace-based steels?
- Challenge from DRI-based processes? (potential implications of lower-cost gas?)